SCIENCE.

AN ILLUSTRATED JOURNAL PUBLISHED WEEKLY.

Vérité sans peur.

NEW YORK: THE SCIENCE COMPANY.

FRIDAY, JULY 2, 1886.

COMMENT AND CRITICISM.

THE BUREAU OF EDUCATION has made a valuable addition to our educational literature by its recent publication of a paper by Dr. E. M. Hartwell of the Johns Hopkins university, on physical training in American colleges and universities. '*Mens sana in corpore sano*,' is perhaps as familiar as any classical quotation to collegiate trustees and professors, but in the past they have been inclined to trust too much to time and luck to give it a practical application. The progress we are now making in organized physical education is the most significant fact brought out by Dr. Hartwell's investigations. He shows that until 1859 no college in the country possessed a commodious and well-furnished building devoted to the purposes of physical training. In that year, however, Amherst, Harvard, and Yale built gymnasia. Amherst seems to have been the most progressive in this matter; and though its first gymnasium has since been replaced by a costly and much-improved building, yet from the first, physical exercise has been required there of all able-bodied students, and it has been directed by an educated physician with a seat in the faculty.

The Hemenway gymnasium at Harvard, and the supervision of Dr. Sargent, have not only given a great impetus to physical training there, but Dr. Sargent's system of directive exercise has been widely adopted. Since 1879, forty-eight institutions have fitted up their gymnasia with Dr. Sargent's apparatus; and his directions are now followed in very many of them, including Amherst, Cornell, Haverford, Johns Hopkins, Lehigh, and Swarthmore. The same system has just been introduced into Lafayette, and is projected at Vassar and the University of Vermont. The statistics and detailed information that accompany the paper are of great value and interest, but its general tenor is more valuable and interesting still. It shows that education — physical, intellectual, and moral, as the phrase is — has become something more than a meaningless motto in many of our leading educational institutions.

THE TRUSTEES OF THE Elizabeth Thompson science fund have made the following grants for research from the income of the fund: 1°, H. M. Howe of Boston, Mass., seventy-five dollars, for investigations on the fusibility of slags from the smelting of lead and copper, to be carried on in the mining laboratories of the Massachusetts institute of technology; 2°, two hundred dollars to the New England meteorological society, for the working-out of results from the very numerous data which are now collected by the society concerning the movements of local storms; 3°, one hundred and fifty dollars to Samuel Rideal, Esq., of University college, London, for the continuation of Tyndall's experiments on the absorption of radiant heat by aromatic gases; 4°, five hundred dollars to Professor Rosenthal of Erlangen, Germany, for researches on the production and regulation of animal heat in health and disease, with special reference to fevers. As the number of applications was very large, the sums asked for amounting to about thirty thousand dollars, it became necessary for the trustees to refuse several applications which entirely commended themselves on account of the character of the applicants and the nature of the proposed work. The invidious task of selection was of course difficult in the extreme, so that it is unadvisable to give the grounds for the preferences finally adopted. On the other hand, the very number of applications increases the probability of the fund being devoted to the support of thoroughly fruitful researches. It is a somewhat unexpected turn of fortune's wheel which delivers an American endowment, even in part for the prosecution of research, at a German university; but it should not be overlooked that the fund was established primarily to further the utility of the proposed international scientific congress, and that

it would violate the spirit of the trust to confine the grants to persons in this country. There is, so far as we are aware, no other endowment of science so generously wide in its scope: we hope, therefore, that it will always be employed to assist only the very best work, and that the trustees will so earn the faith of the public, that the endowment will be very largely increased by liberal patrons.

In a recent number of *Science* (vol. vii. No. 160, supplement) we published several articles by Mr. J. A. Allen and others on the destruction of our native birds. Facts and figures were presented, tending to show that the killing of birds for millinery purposes and for food, together with their destruction in wanton sport, was liable to cause a serious diminution of our birds, and perhaps the extinction of some species useful to man or desirable for their song. The views thus expressed were indorsed by a committee of the Society of natural history of Cincinnati, in a report to that body; and this report has brought out a reply from Dr. F. W. Langdon in an address before the same society, in which he dissents from our conclusions. He points out that the birds most largely used for millinery purposes are those living by the seashore, such as gulls, terns, herons, and others, which are not song-birds nor beneficial to the farmer. As for the destruction of the birds in such places as the Everglades of Florida, he thinks these are doomed to extirpation in any case when the growth of population shall have led to the clearing and draining of the swamps. He admits, however, that some song-birds are made use of by milliners; but he gives some results of his own and others' observation which seem to show that the number of such birds destroyed is not very great. He adds that most of our familiar song-birds, such as thrushes, wrens, and finches, are in little demand for millinery use, owing to their being usually of plain colors, but does not seem to notice that their skins may be dyed. Mr. Allen, in his article above referred to, had estimated the number of birds required in this country to meet the demands of the milliners at 5,000,000 a year; but Dr. Langdon thinks, that, even if this estimate is correct, the loss of that number of birds in a year will have no appreciable effect on the aggregate. He estimates the total number of birds on the continent at 3,000,000,000, and the annual increase at the same number; and, allowing a second 5,000,000 for the demand from other countries than our own, he finds the percentage destroyed each year to be very small. He infers, therefore, that, even if all the birds destroyed were song-birds or birds useful to the agriculturist, the annual loss would have no practical effect on the fauna of the country at large.

Mr. Francis Galton has been devoting the last year or two to a study of stature as an hereditary trait. From a large number of family records, in which the heights of the members of at least three generations are recorded, he attempts to assign the proportionate contributions of each ancestor towards the height of the descendant. He has formulated a law which partly opposes and partly supplements the common notion that the children of parents both possessing certain qualities will probably have the same qualities in even a greater degree than either parent. This law maintains that a constant tendency to mediocrity exists; that the qualities of the parents will not summate, but the average will be the probable result. Perhaps none of his ingenious researches will meet with more criticism than this, it seems to run counter to so many well-known facts of heredity. The research with regard to stature is only a typical one. In a more recent report he has carried over the same method to the consideration of the color of the eyes as affected by heredity, and shows the validity of the law in this field. Mr. Galton has presented his views in his presidential address before the British association and in articles in the Journal of the anthropological institute; but the full paper will appear in the Proceedings of the Royal society, and perhaps a judgment ought to be suspended until all the facts are in.

Several instances have been reported in the past few months where large numbers of persons have been made sick by ice-cream. The theories which have been advanced to explain this result have been many and various. By some it has been attributed to the absorption of copper from the vessels in which the cream was made; others have thought it due to decomposition of the gelatine which is now commonly used to give stiffness to the cream; while still others have thought it might be traced to disease in the cows from which the milk was obtained. Prof. V. C.

Vaughan, of the University of Michigan, has recently investigated the poisoning of a number of persons by ice-cream at Newton, Mich., and is reported to have found tyrotoxicon present in the ice-cream which produced the sickness. This had been previously discovered by Professor Vaughan in pieces of cheese which had caused sickness, and which had been submitted to him for examination. Whether this poison is due to a germ, or to a chemical product, does not yet seem established; but it is but another proof of the possibilities of milk, either infected or decomposed, acting as a factor in disease, and it is not improbable that diarrhoeal diseases so common among the infantile population in the summer months may be caused, or at least aggravated, by milk which contains the tyrotoxicon.

THE BILL authorizing the President to appoint a commission to investigate yellow-fever and the methods proposed for its prevention has passed the senate, and, as there is now no opposition to its passage in the house, there is every probability of its becoming a law. In the mean while, Dr. Freire, who claims to have discovered the microbe of the disease and a method of inoculation to prevent its ravages, is reported to have performed the operation upon seven thousand persons living in localities where yellow-fever is prevailing in a most malignant form. Of this large number, but eight have died. During the same period, some three thousand uninoculated persons have succumbed to the fever. Should the bill to which reference has been made obtain a place in the statutes, these claims of Freire will be subjected to rigid investigation by the best American experts, and, if substantiated, will doubtless be the means of introducing his system, or a modification of it, into the United States, whenever yellow-fever shall again appear in epidemic form.

IT HAS ALWAYS been difficult to understand how the germ theory of disease could be true, and yet the diseases which are due to germs could vary so much in virulence; at times being exceedingly mild, and again malignant in the highest degree. Dr. Sternberg, in a recent paper published in the *Medical news*, makes this very clear, thus removing what has to many seemed an insuperable objection to the acceptance of the germ theory. Germs which produce disease, that is, pathogenic germs, are subject to great modification as regards this power. Germs which to all appearances are the same, and which, so far as we know, are in fact identical in most particulars, may yet differ in their virulence; being extremely so under some circumstances, and but slightly so under others. It is for this reason that virus may be 'attenuated,' as it is termed, Thus the microbes which produce fowl-cholera in a fatal form may, after two or three months, lose this virulence, and still possess some pathogenic power. It is this principle of attenuation which enables experimenters to inoculate animals with the same microbe, but of gradually increasing virulence, until perfect protection, even against the most virulent form of the disease, is assured. A mild attack of scarlet-fever is explained, therefore, not on the ground that only a few microbes of the disease exist in the body of the individual attacked, for we know that this form of life multiplies with enormous rapidity, but by the probable fact that the microbes in this individual case possess a mild degree of virulence.

The further and deeper research is made into this domain of bacterial life, the more apparent does it become that disease-producing germs are wide-spread and abundant; and, if animals susceptible to any particular variety come in contact with that variety, it is easy to understand how disease may be contracted, even when no other animal has been brought in contact with them. For instance: the bacillus which causes fowl-cholera is found in various parts of the world in putrid substances, and as a result epidemics of fowl-cholera are most frequent among fowl that are kept in unsanitary conditions. In the same way typhoid-fever and cholera may develop irrespective of human intercourse or *fomites*. Much of this may seem trite, but the tendency of the present day is to ignore filth as a factor in the production of germ-diseases, and to limit their causation to the presence of other similarly affected persons or animals, and to the articles which have been in contact with them. In helping to clear up the question, Dr. Sternberg has done good service.

THE ECONOMIC DISCUSSION IN SCIENCE.

IT is often doubted whether any good comes of polemical discussion in a periodical; and so obvious are the disadvantages under which those labor who would maintain a scientific position in

popular debate, that many refuse to attempt it under any circumstances. Points are brought up which require lengthy elucidation, and that must be compressed into a single sentence which ought to be elaborated in an entire article. Then it is necessary to assume certain primary considerations; for, should it be endeavored to begin at the beginning and prove satisfactorily to the writers themselves every step taken, it would end in the construction of a complete scientific treatise which might fill several volumes. I believe the representatives of the new school of economics who undertook to prepare a series of articles for *Science* on a number of economic topics were fully aware of the difficulties of their task, and it is certain that the invitation of the editor of this journal was accepted with hesitation. Nevertheless, I must be allowed to express satisfaction with the general course of the discussion so far, and I am convinced that the readers of *Science* have obtained new and valuable ideas from the able articles both of Dr. Seligman and of Professor James. However familiar the views so well set forth in these articles may be to Professor Newcomb, there is no evidence of an acquaintance with them on the part of what might be called the educated American public, and it is unquestionable that they differ in radical particulars from the economic doctrines current in our magazine and newspaper literature. As a matter of course, these articles have been scarcely more than suggestive. It was not intended that they should be exhaustive, for that was impossible within the limits of the assigned space.

Professor Newcomb's article illustrates vividly the difficulties of a discussion of economic theories in a periodical. He sweeps over an immense field, touching on the development of economic doctrines, on the functions of the state, enlarging a little more on the relations of economics to ethics, and concluding with an irrelevant allusion to the condition of American shipping.

I should desire a volume — and a large one — to expose all the errors which, in my opinion, are implied in the article of the distinguished mathematician of the Johns Hopkins university. I will nevertheless endeavor to set a few of the points involved before the readers of *Science* in such a manner as to enable them to understand better the nature of the controversy, and to help them to follow out the argument in their own thoughts.

First, I must begin with a personal explanation. There seems to be an implication, though doubtless inadvertent, in the article of my learned colleague, that I am a socialist. True, I believe that the state has its industrial sphere, and that a larger one than many have been inclined to think; but I hold quite as strenuously that the individual has a sphere of economic action which is an equally important one. I condemn alike that individualism which would allow the state no room for industrial activity, and that socialism which would absorb in the state the functions of the individual. Doubtless I have written more or less about socialism, and I have attempted to tell the truth about socialists, for I have not believed that the generally accepted lies about them could be of any avail to society. The university of which I have the honor to be a member has adopted for its motto the grand sentence, '*Veritas vos liberabit.*' This I accept and have found a source of inspiration. I may go even further. I believe that the socialists have added to our stock of economic knowledge, and that we have a great deal to learn from them. On the other hand, it is safe to say, that, among those who are known as the new school of political economists, there is not a single one who could be called an adherent of socialism, pure and simple. It is, I believe further, safe to assert that pure socialism is advocated by no teacher of political economy in any American college or university. Professor Newcomb finds the present economic discussion — as yet incomplete, be it remembered — disappointing, and because more has not been said about the state, since "the main point in which the new school is supposed to differ from the other is that it looks with more favor upon government intervention in the processes of industry and trade." Of all the articles in this series, only one deals exclusively with the state; and yet the topics were selected by the writers of these articles. Is not this in itself a sufficient refutation of this popular supposition? What those who consented to write these articles desired was to place before the readers of *Science* an outline of their fundamental doctrines. They wished to present their opinions as they in reality are, not as people might suppose them to be. In my article I ventured the opinion that the radical difference between the old and the new school consisted, *not* in the views held of the state, but in the establishment of a new relation between ethics and economics. Others, possibly the majority, find the main difference in method, about which Professor Smith of Columbia is to contribute an article. It is necessary in all discussion to grasp the fundamental fact that what one believes, and what one is said to believe, are two quite different things.

Professor Newcomb claims that nothing new has been said in regard to the state, because every one is willing to admit that state intervention is right if it is useful. I am glad that it is admitted that state intervention is considered as merely a question of utility. It is a great deal to have gained that point, and to be able to quote Professor Newcomb in favor

of the position. This is very different from the ordinary view, which is that the state has no right to participate in economic and industrial life. Some time ago Dr. Lyman Abbott wrote an article for the *Century magazine* in which he raised the question, whether the United States would not have done better to build and manage itself the Pacific railways rather than to give vast empires of land, and millions in money, to corporations to induce them to construct those great highways. His argument was presented with a great deal of force; but, in a later issue of the magazine, space was given for an objection. In what did the objection consist? Simply the dogmatic assumption that it was not the province of government to construct and manage railways. It was not regarded by the writer as essential to prove that it would not have been useful. When the question was raised recently in Philadelphia, whether the public gasworks should be sold to a private corporation, many newspapers thought it an argument to urge that it was not the function of a municipality to furnish gas. These are typical cases; and it is, I repeat, a satisfaction to be able to cite Professor Newcomb as an authority against such dogmatism.

Again: the article by Dr. James is criticised because 'there is so little to object to in it.' This is another concession which must give satisfaction to many members of the new school. It differs widely from prevailing public opinion; and even so liberal and progressive a man as Professor Taussig thinks that Professor James 'goes too far.' A new theory of taxation is suggested by Dr. James, which is, I think, of far-reaching importance. It is not at present received either by our legislative or our judicial bodies.

Professor Newcomb's position as first stated, in regard to the development of economic thought, differs not in one whit from that of the new school. Adherents of this school all regard economics as a development, and, without exception, they value the works of their predecessors. They were the first in America to give a proper position to Adam Smith, Ricardo, and Malthus, by the introduction of courses in the history of political economy into our colleges. In the 'Statement of principles' of the American economic association, it is expressly declared that 'we appreciate the work of former economists.' Again: it is pleasant to be able to agree with Professor Newcomb; but, as a matter of fact, this is a different opinion from that which was a short time ago current. Writers, not long since, looked upon political economy as a complete and perfect science, true for all times and all places. Buckle and Lord Sherbrooke advocated this view; and even Professor Laughlin of Harvard, who probably does not regard himself at all as a representative of the extreme 'orthodox' school, conveys the impression, in his useful little work on methods of instruction in economics, that there is, after all, not much constructive work to be done in our science. When Professor Newcomb, however, begins to criticise Dr. Seligman, I am unable to agree with him; for he speaks as if political economy were a mathematical science, with a body of truth unchangeable and eternal, like the statement, "A straight line is the shortest distance between two points." It is, according to this view, only the application of fixed principles which must be changed with time and place. Now, what is this body of mathematical truth in economics? There are some truisms in economics of that nature; but a large and important body of such principles I have never been able to discover, though I have searched for it long and diligently. It seems to me that Professor Newcomb fails to distinguish between mathematical sciences and those which are more descriptive in their nature, and have to do with growing, changing bodies.

This brings us naturally to Professor Newcomb's objection to my conception of economics as a science concerned with what ought to be, — an objection which it seems to me, though very natural in a mathematician, is not valid. I believe all sciences which treat of concrete organisms consider what ought to be as well as what is. The scientific physician treats of the perfect body as well as of the diseased, imperfect body. The biologist observes living forms, and expresses approval and disapproval. Natural sciences treat continually of purpose and adaptation to ends. Who can so well treat of social remedies as he who has studied society? Why stop when we have reached that point which first renders our science useful?

Professor Newcomb implies the argument, formerly a favorite one and still too common, that selfishness and enlightened philanthropy lead to the same ends. Observation does not confirm this. To a certain extent their courses will be parallel; but in important particulars there will be a divergence, and that divergence will be the difference between health and disease. His illustration of the treatment of the servant 'Cuffee' is pertinent. A careful observer will note a very different treatment of him by a selfish lady, and one who applies the dictates of ethics to her everyday life. This difference will affect the welfare of 'Cuffee' materially. I dismiss the question "Would he (Professor Ely) have Cuffee trained into a novelist, a chemist, or a metaphysician?" as not pertinent to the discussion, and as being, in fact, the exact opposite of what I did say. Not to weary the readers of *Science*, and not to make

too large demands on the available space of this journal, I will conclude with one further general consideration.

Professor Newcomb closes his article with the statement of an objection against state intervention, based on the observation that our congressmen, and I suppose our rulers in general, are not a very wise body of men, and presumably do not know better than others what is for our good. This shows, it seems to me, a total misapprehension of the question involved. Nobody wants to intrust certain things to the government because the government is very wise and very good. Nobody desires paternal government. Even the extreme socialist does not desire it. What he wishes, and believes practicable, is a fraternal commonwealth. The question involved is not, "Shall we let wiser and better people than we attend to our affairs for us?" but "Shall certain functions be performed by co-operative methods, or by individual methods?" for the state is only a certain kind of co-operative institution. Then, if we decide on co-operative methods, shall we adopt voluntary co-operation, possibly that of a corporation, or shall we adopt the compulsory co-operation of the state?

Now, inquiry shows that certain functions are adapted for individual effort, that certain others will be best performed by voluntary co-operation, while still others can be accomplished most advantageously by the compulsory co-operation of the state or of some subdivision thereof. What these are, space does not permit me to say in this place.

I have, however, laid down a few simple rules elsewhere;[1] Prof. Henry C. Adams has gone into the subject far more at length in his paper, "Principles that should control the interference of the states in industries;"[2] while valuable suggestions may be found in the admirable monograph of Dr. James, on the "Relation of the modern municipality to the gas-supply," just published by the American economic association. It is enough, if in this series of articles the general points of view of the new school can be impressed upon the readers of *Science*. It may be remarked, however, that 'interference' is not so good a word as 'participation' to denote the activity of the state; for it is not opposed to, but, if wise, in the line of the desires of the people, and precisely on that account it is not generally noticed how large is its sphere.

Finally, the case is not nearly so hopeless as one would gather from Professor Newcomb's observations. Experience, sooner or later, teaches the people many wise things. It is the function of the economist to help the people by more careful observation, and thus to shorten the term of unfortunate experimentation, and to lessen the cost of that dear teacher 'experience.' Take the case of the post-office. Experience and science have decided that its functions should be performed by public authorities, trial having been made of private enterprise. That question is settled, and the benefits of correct practice are inestimable. Take the case of letter-carriers in cities. They are a great saving and convenience. I suppose, in a city like Baltimore, the time they save to citizens must amount to hundreds of years in each year. The benefits derived from letter-carriers are equal to those of great inventions, but they have been demonstrated, and are secure. I think the railway problem, now prominent, will be settled in the same way; that is, by experience, aided largely by science.

It is not necessary that the majority, or even a great many, — that is, compared with the entire population, — should have special and profound knowledge in economics in order to secure intelligent economic action. The influence of two or three men 'who know' is enormous when exerted at the right time and in the right place. I suppose six men in congress who thoroughly understood public finance could, at the beginning of our late civil war, have shaped the financial policy of government for years to come.

I wish again to call attention to the forcible illustration to which allusion has already been made. A few months since, the question was raised whether the gas-works of Philadelphia should be sold. Few understood the question; and it is said that a systematic agitation in favor of private works was conducted by a vast corporation, which had its eyes fastened on them as a mine of wealth. But there was one man in Philadelphia who did understand the question in all its bearings, and that was Dr. James. He came forward and set the matter in its true light, and I have been told that his influence was decisive. At any rate, it had weight, and the gas-works remain to-day the property of the municipality. That decision was worth many millions of dollars to the city of Philadelphia, and is an illustration of the value of the higher education. All that the University of Pennsylvania ever cost the citizens of Philadelphia, either in their private or public capacity, is a small matter compared to the value to that municipality of a single man who occupies a chair in that institution of learning.

Richard T. Ely.

[1] In my 'Introduction to the labor problem,' published by Harper and Brothers, 1886.

[2] A lecture printed in pamphlet form by the Constitution club of New York.

THE EXISTENCE OF A MAGNETIC SENSE.

SINCE the day when Thales, about twenty-four hundred years ago, rubbed a piece of amber on silk and found that it attracted light particles, the phenomena of magnetic action have been regarded with feelings of awe and mystery. The strange entrancing of animals brought about by an intense fixation of their gaze was referred to 'animal magnetism,' because nobody understood either the one or the other. The discovery of the magnetic needle, and its mysterious constant pointing towards the north, added another element to the wonders of magnetism. Mesmer was keen enough to see, that, by explaining the hypnotic phenomena to which he gave his name as due to 'magnetism,' he was treading on safe ground. That elastic cabinet of mysteries could easily be made to accommodate another series of peculiar facts, and the theory had thenceforth a habitation and a name. The mere mention of so-called magnetic cures is sufficient to suggest a host of alleged facts and wonders. Although all such phenomena assume that the human body is susceptible to the influence of the magnetic field, Baron Reichenbach, in a series of experiments since become famous, was the first to attempt a scientific proof of such an influence. He thus described his 'sensitives,' who were variously affected by the presence of a magnetic field: some saw flames issuing from the poles; some had disagreeable organic sensations; some were benefited by it; and so on. These experiments were repeated by Professor Barrett of the English Society for psychical research, but altogether with negative results, until the young men who had done such good service in the thought-transference department were called in to describe the effects of a magnetic field upon them. They saw the lights issuing from the poles, and felt the pains in the temples when very near the magnet. Before these experiments, Sir William Thomson had expressed the opinion that it would certainly be strange if no magnetic sense existed. The fact that nothing happened when he put his head between the poles of a powerful magnet, he regards as very wonderful. Finally, French observers have recorded the fact that hypnotics who have responded to the suggestion that one-half of the body is affected in a certain way (e.g., one arm is insensitive) will have the affection transferred to the other side of the body, and removed from the first side (i.e., the other arm will become insensitive), by the application of a magnet on the opposite side of the body.

The above hasty sketch of what has been done towards solving the question of the possible effect of a magnet on human nerves seems to suggest that a rigid scientific test upon normal persons is highly desirable. It was to supply this want that the experiments about to be described were undertaken.[1] The special points which were borne in mind were, 1°, to exclude the action of chance; and, 2°, to rule out all possible modes of suggestion as to what was going on. We believe that we accomplished these objects by using the following method and apparatus. A large and powerful electro-magnet was tipped on its side and supported between two tables. The head of the person to be tested (to be called 'the subject') was placed between the poles of the magnet, with the forehead and back of the head all but touching the poles. He was seated upright in a chair, with his head in a normal and fairly comfortable position. The magnet and the subject were on the third floor of the building. In the room on the ground-floor there was a dynamo-machine, which, when turned by the operator, generated the current. The magnet was connected with the dynamo by heavy insulated wires passing out of the windows and along the wall of the building. The subject and the operator communicated by a system of telegraphic signals: otherwise they were completely isolated from one another.

At the first stage of the experiments the following method was employed. After the operator had received the signal that the subject was ready, he did one of two things: 1. He turned the current on, and when, after a short interval, the subject signalled 'Change,' he turned it off, turning it on again when the second 'change' was signalled; 2. He began by doing nothing, turned the current on at the first 'change,' and off at the second. In either case he received a signal from the subject when the observation was concluded. In each observation the subject knew that the condition of the magnet at the beginning and at the end of the experiment was the same, but that in the middle, between the two 'changes,' the time of which he himself directed, the condition was different. His object was to tell whether the magnet was on or off at that intermediate time. His opportunities for judging were extremely favorable, for he knew exactly when to expect the sensation of a change from one condition to another; and he knew that in one case it would be change from magnetization to demagnetization, and in the other case a reverse change. He had simply to tell which was which. It is evident that by mere guesswork he would answer correctly one-half the time,

[1] The experiments were conducted in the psycho-physical laboratory of the Johns Hopkins university. Dr. G. H. F. Nuttall was associated with me in the work.

for he had only a choice between two things, one of which was right and the other wrong. The number of correct answers above one-half the total number of answers would measure the magnetic sensibility.

Experimenting in this way, we were surprised to find that considerably more than one-half the answers were correct. Apparently the magnetic sense was there. But it was soon observed that we more or less consciously judged by the sound that the turning of the dynamo transmitted along the wire, and thus to the magnet. When the attention was once directed to this point, the doings of the operator could be correctly told every time. After many failures, we succeeded in eliminating this sound by cutting the wires, and inserting one end of each into a mercury-cup, and connecting the other by a binding-screw with the cup. The wires were suspended from the ceiling by silk threads, and inserted freely in the mercury: in this way the sound-vibrations were transmitted to the mercury, and only very weakly taken up again by the wire. This arrangement was inserted in the circuit once in the basement room, and again on the sill of the window, as the wires passed the second floor of the building. The turning of the dynamo was thus rendered inaudible; and for a time the results were negative, the number of correct answers being just about one-half of the total number of experiments. But soon the correct answers became more and more frequent. This time the indications were more subtle. As is well known to physicists, the magnetization and demagnetization of a powerful magnet produce a molecular crepitation throughout its mass, which gives rise to a very faint but audible click. It was this click, and not the magnetic sense, that told us when the current was being turned on, and when off. It is remarkable that we used this click as an indication of the condition of the magnet long before we were distinctly conscious of its existence. This click could not be heard every time, but, with the attention sharply focused, almost every time. But it will be objected, as the click accompanied each 'change,' it could not guide the judgment of the subject. This objection would hold were it not that the click accompanying demagnetization is much more pronounced than that accompanying magnetization. In fact, the latter could rarely, if ever, be distinctly heard.

These difficulties were obviated by a slight alteration in the mode of experimentation. At the beginning of each experiment the current was off; at the signal of 'Change,' the current was either turned on or left off. The subject had then simply to decide whether, on the whole, something had been going on during the experiment, or whether the dynamo had not been turned at all. In this way, only the magnetization, and never the demagnetization, occurred in the experiments, and the click was thus avoided. Moreover, to completely guard against the very slight click of magnetization, the current was not made as formerly, by the closing of a key; but, with a key always closed, the dynamo was turned with gradually increasing speed. It is the suddenness of the magnetization that produces the click. It is evident, that, as before, the chances of a correct guess are just one-half. The opportunities for judging are perhaps not as favorable when only one change is made, but it is doubtful whether even this difference is appreciable. It is this latter method that was used throughout the rest of the experiments. In all, ten persons, all students in good health, were experimented upon, including Dr. Nuttall and the writer. The results are given in the following table:—

Subject.	No. of experiments.	No. of correct answers.	No. of correct answers by the action of chance.	Divergence.
J. J.	550	286	275	+ 11
G. H. F. N.	550	287	275	+ 12
M. S.	150	76	75	+ 1
L. B.	100	50	50	0
C. F. H.	100	47	50	− 3
D. B.	100	47	50	− 3
M. E. C.	100	44	50	− 6
W. H. B.	100	53	50	+ 3
E. C. S.	100	51	50	+ 1
H. B. N.	100	50	50	0

This table makes it evident, that, in the case of those experimented upon, no sensibility for a magnetic field existed. This still leaves the question open, whether there may not be a morbid sensibility for such an effect; but it makes such a possibility less probable, because the sensibility for a magnetic field ascribed to 'sensitives' is so intense, that some slight remnant of it might be expected to exist in normal persons. It was intended to test persons who were good hypnotic subjects both in the normal and the hypnotic conditions, but no opportunity offered itself. Our conclusions refer only to the question of a normal magnetic sense.

On what ground the alleged magnetic phenomena are to be explained is another and more delicate question: that the imagination is a powerful and important factor is beyond doubt; and when, as is generally the case, morbidly sensitive patients, especially hysterical girls, are experimented upon, the merest trace of a suggestion, unconsciously given, of the desired or expected effect, is enough to bring about all the phenomena of '*transport*,' etc., for which the magnet has been held accountable. Only when tested under

rigid and scientifically controllable conditions can the evidence of such abnormal sensibility be relied upon. Even the precautions against indications as above described would probably have to be added to, if hypnotic subjects were experimented upon.

In conclusion it is desired to lay stress not only on the negative character of the results, but on the method employed, and especially on the fact, that, as the precautions were rendered more and more effective, the negative character of the conclusions became more and more evident.[1]

JOSEPH JASTROW.

LONDON LETTER.

No more interesting and valuable report has been presented to parliament during the recent session than that of the inspectors of explosives for 1885. Colonel Majendie and his colleagues have been engaged for ten years in protecting the public against the most terrible dangers to which modern science has exposed it. A list of twenty-nine men is given who have been caught and punished for complicity in what are usually known as dynamite outrages. In 1885, 133 ordinary explosions due to accident came under the notice of the Home office, and some almost incredible stories are told of carelessness in connection with explosives. The explosion of tablets of chlorate of potash in the pocket of a gentleman in Brookline, Mass., who dropped his watch upon them quickly, is characterized as the most curious explosion of the year. Among other 'explosive medicines' is mentioned nitro-glycerine, which is made up with lozenges, etc., for use in cases of angina pectoris and other complaints. In the United Kingdom, 22,268 houses are registered for the keeping of explosives. It is the duty of the local authorities to see that the provisions of the act are complied with. Sometimes, however, they are very remiss, and the inspectors act as a useful check upon them. In 1885, 392 places where explosives were kept for retail sale were inspected, and in some cases they were found to be 'about as bad as they could be.' London, Liverpool, Bristol, Birmingham, Sheffield, Huddersfield, and Bath are selected for special commendation in this respect.

At the last meeting of the London section of the Society of chemical industry, a very valuable paper was read by Dr. Meymolt Tidy on the chemical treatment of sewage. Premising that he had for many years read every thing he could get hold of on the subject, and had also gained practical personal experience therein, he defined sewage as "the refuse of communities, their habitations, streets, and factories." Its very complex nature was commented upon. Two elements were constant, and 'the rest nowhere:' viz., 1°, excreta (every thousand people gave, on a very large average, 2,640 pounds of liquid, and 141 pounds of dry, sewage daily); 2°, roads (if wood-paving be excluded, road-washings contained, on an average, 280 grains of solid matter per gallon, of which 120 were in solution). The extreme difficulty of obtaining fair samples was amusingly commented on; and the salutary effects on sewage, of air and of dilution, as shown by the appearance therein, or otherwise, of comparatively high forms of microscopic life, such as the Vorticella, Rotifera, etc., was pointed out. An unfailing characteristic of sewage was the presence of hairs of wheat, and of *free* spiral cells, their casing having been dissolved in digestive processes. Authorities were agreed upon two points; viz., that the valuable matters were in solution, and the offensive in suspension. Irrigation could not be relied on for giving absolutely continuous purity. Of the precipitation processes, those in which lime and alumina were employed successively, gave the best general results; and the smell still remaining might be entirely got rid of by causing the effluent to flow over a little land. This combination was probably the best method of dealing with liquid sewage; but, in Dr. Tidy's opinion, the whole system of water-carriage of sewage was a mistake. It was absurd to take expensive and elaborate precautions about purity of water-supply, and then only to use one-ninetieth of this for drinking, allowing the rest to be polluted. The dry-earth system of dealing with human excreta was the only proper and scientific method.

The second, and ladies', *conversazione* of the Royal society was held on the evening of June 9. Many of the objects of interest exhibited at the former one were on view again. Among the novelties were the following: some microscopic sections, diagrams, and specimens illustrating the alteration artificially produced in vitreous rocks by the action of heat alone, by Mr. F. Rutley; floral studies in Chili, of orchids, nests, etc., by Miss North; illustrative diagrams of and specimens from Roraima; some rare earths from Samarskite, Gadolinite, etc., with illustrations of their phosphorescent spectra, by Mr. W. Crookes; pumice, volcanic ash, drawings, diagrams, etc., illustrative of the great volcanic eruption, by the Krakatoa committee of the Royal society; ap-

[1] The above is simply a general account of the experiments. For a detailed account, the reader is referred to the full paper on the subject, to appear in the next number of the Proceedings of the American society for psychical research.

paratus employed in the examination of air for micro-organisms, by Dr. Percy Frankland; and a remarkable collection of gems, by Mr. Bryce Wright. Photographs of celestial phenomena and microscopic sections of devitrified rocks were exhibited in the lime-light-lantern, and demonstrated by Mr. Norman Lockyer, Mr. Common, and Mr. Rutley; and the United telephone company had established temporary communication with the Savoy theatre, where 'The Mikado' was being performed.

The annual meeting of the Marine biological association was held on June 8, Professor Huxley, the president, in the chair. The council's report mentioned a small increase in the number of members during the year, and the progress that has been made with the plans for the new laboratory at Plymouth, which will be commenced immediately. It is hoped that it may be in working order by the autumn of next year. Much interest is taken in it by the residents of Plymouth, one of whom, hearing that the council of the association were contemplating the omission, for pecuniary reasons, of certain desirable features in the building, has generously offered to provide the five hundred pounds necessary for the purpose.

A large amount of valuable zoölogical work has been recently carried out by the Liverpool marine biology committee, which was established some two years ago. The shallow water off the coast of North Wales and round the Isle of Man has been systematically explored with the dredge, with the following very gratifying results: whereas only 270 species of marine invertebrates were known from this neighborhood before 1853, 913 species are recorded in the report of the Liverpool committee. Of these, 235 were not previously known in the locality; 16 are new to British seas; while 7 species and 3 varieties are new to science. W.

London, June 14.

NOTES AND NEWS.

THE Lackawanna institute of history and science, recently founded at Scranton, Penn., has taken steps for the purchase and preservation of the two great glacial pot-holes found in the Lackawanna valley at Archbald. An illustration of one of these pot-holes was published in *Science* for Dec. 19, 1884. The second one has not yet been cleared out, but will be cleared by the Lackawanna society. These holes are described by Professor Branner in his recent paper upon the glaciation of the Wyoming and Lackawanna valley.

— The destructive effects of poisoning by phosphorus are narrated in a paper read at a recent meeting of the Ohio state medical society by a physician whose practice has been large in one of the most extensive match-factories of that state. He finds that the head of each match contains about a seventieth of a grain of phosphorus, and that the injurious results of the process are most marked among those who work in the dipping and packing rooms. The affection is a disease of the bones of the jaw known as necrosis. In some it appears within two years after they enter the factory; in others its appearance is more delayed. Operatives with unsound teeth are the most susceptible. He recommends that only persons possessing sound teeth be employed in these two rooms; that thorough ventilation be provided in all parts of the factories; that the operatives be not permitted to eat their meals within the factory or with soiled hands; and, finally, that mouth-washes of the alkaline carbonates be freely used.

— O. P. Jenkins was elected, June 23, professor of biology, and curator of the museum at DePauw university, Greencastle, Ind.

— The *Sanitarian* records an instance of flies acting as sanitary inspectors. In one of the rooms of a residence in an eastern city, offensive odors were detected, but their exact source could not be located. The carpets were raised, and a carpenter engaged to take up the entire floor. At this moment a friend who chanced to come in, suggested that an appeal be made to the instinct of the fly. Two blue-bottles were brought from a neighboring stable, and the doors and windows of the room closed. The flies soon settled upon one of the cracks in the floor, and, when the boards were raised at this point, a decomposed rat was found.

— The Japanese disease beri-beri, or kakké, is now regarded as a contagious disease, having for its cause a microbe. The infection enters through the intestinal canal, and locates itself at this part of the economy.

LETTERS TO THE EDITOR.

*** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

The flight of the flying-fish.

THE question, among naturalists with whom I have been associated, as to whether or not the flying-fish flaps its wings during its flight, was at first a great surprise to me. My years of sea-service, without hearing a single doubt upon this point, had been exclusively among seafaring men, who are generally positive: naturalists seldom are. Nevertheless, association with the former teaches one that their 'opinion' on a subject is, as a rule, a confirmed belief.

In the region of the Cape de Verde Islands, where a very large species of flying-fish is abundant, it is easy to observe the beating of the creature's wings;

but on our own coast, where the fish — and wings — are small, the vibration is so rapid, that, at the usual distance, one cannot well distinguish the motion.

Viewing the question from an engineering standpoint, the problem resolves itself into a simple calculation, the only element of error being in the correctness of observation: for the flight of the fish can only be observed from the deck of a vessel, and the direction of the creature's flight must, at best, be an approximation. The mean of a large number of observations, however, should give a result very close to the truth. Though the flying-fish usually starts directly to windward, it seldom continues in that direction; and, because of this erratic flight, the observation is still more difficult.

The opinion of the naturalists was that the creature projected itself out of the water with great velocity, in a direction opposite to that from which the wind was blowing, and, by placing its wings (pectoral and ventral fins) at an advantageous angle, so pressed them against the atmosphere as to lift its body, while its inertia carried it forward over the surface of the sea like the projectile from a gun. In this event two forces would be acting upon the fish: that of gravity, to pull it to the water; and the resistance of the atmosphere, to retard its forward velocity. Its motion of translation would essentially be uniformly retarded. As its velocity diminished, it would be obliged to alter the angle of its wings, in order to preserve its horizontal line of flight; and this movement would present a greater projected area of wing to the direction of its flight, and therefore its motion would be retarded in a greater ratio than that of a fired projectile having a constant plane of resistance. Artillerists, both on land and sea, are satisfied that they can distinguish the retardation of a cannon-shot: indeed, I doubt if one can be found who would question it; and yet seafaring men are positive the flight of flying-fish is uniform.

A school of flying-fish will keep together in the air quite as well as a flock of ducks. As nearly as one can judge from looking at them, they move at the same velocity. Now, if they continue to move at equal velocity, and do not flap their wings, it follows that they must have projected themselves from the water with equal velocity, and that there must be a constant ratio between the area of their wings and the weight of their bodies. That this is not true is evident, from the following measurements made early in April of this year, from three live specimens of Exocoetus robustus[1] as soon as they were taken from the water.

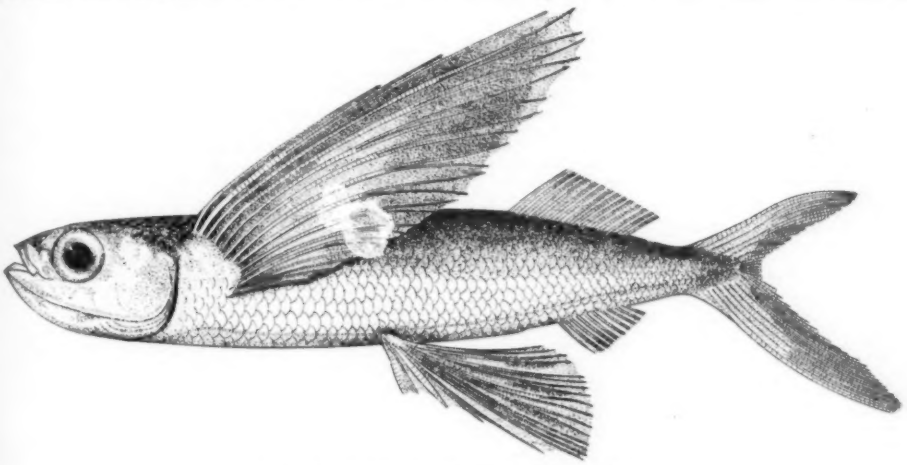


FIG. 1.—FLYING-FISH (EXOCOETUS ROBUSTUS).

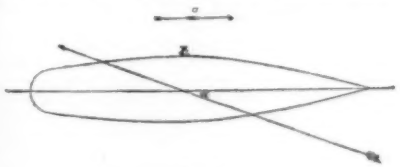


FIG. 2.

Number of the specimen.	Length of pectorals in inches.	Length of ventrals in inches.	Area of each pair of pectorals in square inches.	Area of each pair of ventrals in square inches.	Total area of wing-fins in square inches.	Weight of the fish in ounces, avoirdupois.	Ratio of area to weight.
1	5 1-4	2 1-2	21.328	6.797	28.125	5	5.625
2	3 5-8	2 5-16	8.700	5.261	13.961	2	6.9805
3	3	1 7-8	7.314	3.896	11.210	1.5	7.473
Mean	3.958	2.1458	12.447	5.318	17.765	2.833	

[1] Specimen identified by Dr. Tarlton H. Bean.

The writer was fortunate enough to observe a flying-fish (on the 9th of April, 1886) moving in a direction apparently parallel to that of the ship, and with equal velocity. By means of a Casella anemometer the velocity of the wind across the ship's deck was found to be 13.6 feet per second, and its direction was 20 degrees from ahead.

Referring to fig. 2, b represents the ship; c, the fish; and a, the angle of the wind. The true velocity of the fish through the air was then $13.6 \times \cos a = 12.78$ feet per second.

Let us take, for example, a specimen whose wings and weights would be a mean between the three specimens recorded.

Let A represent the area of its wings in square feet $= \frac{1.7+1.6}{14.4} = 0.1234$; V, its velocity in feet per second $= 12.78$; A′, the projected area of the wings; W, the weight of a cubic foot of air in pounds $= 0.075$.

In experiments with flying-machines (R. C. Buel, in Appleton's Cyclopaedia of mechanics, vol. i. p. 53), it has been ascertained that an angle of 54° 10′ is the most advantageous angle at which the vanes can be placed (these vanes are similar to the wing-fins of a flying-fish). Therefore $A' = A \times \sin 54° 10' = \frac{1}{10}$ of a square foot, nearly.

The force with which the air will be pressed downward, or, what is equivalent, the lifting-power of these wings moving at V velocity, will be $\frac{V^2 A' W}{2g}$.

Substituting the numericals above recorded, we have $\frac{(12.78)^2 \times 0.1 \times 0.075}{64.3} = 0.0190307$ pounds, or about $\frac{0.019}{0.177} = \frac{1}{9}$ the weight of the fish in question.

The method of catching flying-fish on board the Albatross affords a means of observing some of their motions. When our submarine (Edison's) lamp is lowered a few inches below the surface of the water, these fish often approach it gradually. On such occasions they invariably have their pectorals and ventrals extended, but do not appear to use them as organs of locomotion: on becoming alarmed, they close these fins, and dart forward suddenly. The brilliancy of the electric light, no doubt, dazzles their eyes greatly, for they do not appear to see objects near them, and, when alarmed by the splash of the scoop-net, dart right forward by use of the caudal fin. Mr. Nye, quickly perceiving this habit, takes advantage of it by plunging the net directly in front of the fish, which he almost invariably catches. On one occasion a fish turned in its flight, and projected itself several feet vertically into the air, very close to the side of the ship, working its wings vigorously, which was distinctly seen by several people on deck.

G. W. BAIRD.

Passed Assistant Engineer, U.S.N.

Washington, June 24.

An Indian snake-dance.

I have received a clipping from the New York *Commercial advertiser* containing a letter from a Mr. Trumble in reference to the article on the 'snake-dance' of the Moki Indians of Arizona (*Science*, vii. June 4). Mr. Trumble mentions the occurrence of similar performances among several Central and South American tribes, and discusses at some length the antidotes used. This feature was only touched upon in my paper for the reason that Dr. H. C. Yarrow of the army, who attended the dance at Wolpi for the special purpose of identifying the species of snakes used, and of determining whether they had been rendered innocuous, was present at the reading of the paper, and was kind enough to discuss it at some length. Perhaps the interest in the question would justify a few remarks on that phase of the subject. Dr. Yarrow identified four species of snakes, only one of which, however, was poisonous, — the spotted rattlesnake, or Crotalus confluentus. He descended into the snake *kiva* on the eve of the dance, and there examined the snakes which were to be used on the morrow. At his request a large rattlesnake, selected by himself, was held up for his examination by one of the Indians, and, upon prying its mouth open, he found the fangs intact and of large size. I may add, that, at the conclusion of the 1883 snake-dance, two rattlesnakes were captured, and sent to the national museum. They were examined soon after their arrival by Dr. S. Weir Mitchell of Philadelphia, who found them in perfect order: their fangs had not been disturbed, and the poison-sacks were intact and full of venom.

The snakes used in the dance undergo a very complicated course of treatment in the *kiva* where they are confined prior to their appearance in public. They are washed repeatedly in various kinds of 'medicine-water,' and are frequently handled or stroked with a downward, squeezing movement of the hand. Whether such treatment prolonged over a period of five or six days is sufficient to render innocuous a robust rattlesnake, is an open question. Both Captain Bourke in his book, and Dr. Yarrow in his remarks, mention seeing a large rattlesnake brought in from the fields on the day of the dance. These, at least, must have been capable of inflicting fatal wounds.

The Indians have the greatest confidence in the means they use to secure immunity. Dr. Yarrow, in an interview he had with the high priest soon after the dance, showed the old man a hypodermic syringe and a solution of permanganate of potassium, which he had brought along to use in case of necessity, and explained to him their use. The old man replied, "No doubt my brother's medicine is good, but we are quite satisfied with our own." The performers are very seldom bitten: I observed but one instance at Wolpi, none at Mashongnavi. Others, however, record two other instances at Wolpi, which escaped my attention: in both of these cases the bite was inflicted by non-venomous serpents. As the number of snakes used at that dance was about eighty, this is not a very high percentage. I am of the opinion that the Mokis rely on the previous treatment of the snakes, on their charms and incantations, rather than on any after-treatment of themselves. As Dr. Yarrow remarked, a snake which had been repeatedly handled, and had discovered that no injury was intended, would become comparatively tame, and this would account for the behavior of the snakes during the dance. In the hands of the dancers, they seem numbed and lifeless, and it was only when dropped rudely on the ground from the mouths of the dancers that they showed any disposition to fight.

The knowledge of the composition of the liquids used by the Mokis is confined to one man, a high priest; even the members of the order are ignorant of it: but, to provide against the loss of the secret, the knowledge is shared with an old woman of the tribe. The high priest keeps this knowledge to himself until he is, or thinks he is, on his death-bed;

he then communicates it to the successor whom he had previously selected, and to whom he had already taught all the other rights and ceremonies pertaining to the dance.

The various liquids or 'medicine-waters' are not procurable by those not in the order, as they are very jealously guarded. Wiki, the high snake-priest, in an interview held after the dances at a ranch in the neighborhood, was quite communicative for a while, but, when this subject was approached, became very much agitated. He said, that, were he to reveal the secret of the preparation of these liquids, his life would be the penalty. Dr. Yarrow succeeded, however, in obtaining a bottle of the liquid used after the dance, and it is now in the army medical museum.

It should be mentioned that these liquids are not looked upon by the Indians as antidotes. The liquid taken after the dance has no direct bearing on the question of poison. In reply to Dr. Yarrow's question as to the object of this ceremony (the vomiting after the dance), Wiki told him that "the presence of the snake between the lips of the dancer caused a profuse flow of saliva, which the dancer was necessarily obliged to swallow, and that if he did not get rid of this saliva, which was poisonous, his stomach would swell up and burst," — an operation, it is hardly necessary to say, which never occurred from this cause; and the account must have been derived, therefore, from some source outside the facts of the case.

Mr. Trumble speaks of gorging on the part of the participants in the dance; he also says the snakes are fed until they become inert, and finds in these practices a partial preventive of evil effects from snake-bite.

Neither of these apply to the Moki dances. The performers go into the dance after four days of what is practically fasting (they eat but one meal each day); and the snakes themselves, so far as I could learn, are given nothing whatever to eat. It is true that in Wiki's accounts the phrase, "and I bathed him, and gave him to drink of the liquid," occurs; but the giving of drink is metaphorical, and consists of sprinkling the snake with the liquid by means of a feather.

I think the study of the rites pertaining to serpent-worship, as they occur among the lower races of mankind, would throw much light on the serpent-symbolism which prevailed among quite highly civilized people; the Egyptians, for example: but our knowledge of the early phases of this form of worship is rather meager. Perhaps the tribes mentioned by Mr. Trumble may supply some of the needed information.

A writer in *Harper's weekly* (March 25, 1882), quoted by Captain Bourke, gives an account of a performance very similar to the Moki dance, but occurring among some Central American tribes. In this ceremony each performer has his own particular snake, which he has previously trained, and with which he performs various feats. This, however, is jugglery, an element which is entirely lacking in the Moki performances. On this point I cannot do better than to quote Dr. Yarrow's closing remarks: "I went to Wolpi expecting to find a good deal of humbug about the snake-dance; I came away convinced of the earnestness and fair dealing of the people, and without a doubt that they fully believed that their ceremonies would bring about the desired result."

I think Mr. Trumble is mistaken about the effects of curari; but the word has been applied to so many different varieties of poison, that it has come to have a rather vague meaning. Curarine, the active principle of curari, is said to cause paralysis of the motor nerves, and it has been used in medicine as an antidote for strychnine and as a remedy in hydrophobia and in tetanus. But this part of the subject I must leave for those better qualified for the discussion. The subject has excited much interest; and many eminent investigators, from the days of Sir Walter Raleigh (who published his account in 1595) down to the present time, have given it their attention. Probably the most complete account is that published by Dr. S. Weir Mitchell and Dr. W. A. Hammond in the latter's 'Physiological memoirs,' 1863.

There is a point in Mr. Trumble's letter which seems to deserve special attention: this is the use, by Indians, of antidotes against poisons. To the savage there is no unknown: every thing is explained; and this explanation is always the most simple, the most direct, and, as a rule, the most superficial, that could be applied. The savage can no more realize the physical causes of phenomena than he can the laws which govern the solar system. Instances of this are furnished in abundance by the Moki myths; but they need not be quoted here, as they occur in all tribes, and can be found in any work treating on mythologic philosophy. The inability to realize the facts of physical causation, the grandest which have yet been discovered by man, is not confined to savages, however, but is present, in a greater or less degree, in what we are accustomed to call the highest civilization. It follows, then, that poison as a physical cause of death is a conception which is beyond the ken of the savage mind, and such is actually the case. Poison, when it is conceived of at all by savages, — and this conception is rarer than is generally believed, — is not thought of as a substance containing in itself its fatal properties, but as being endowed with them by some outside power, — either human, as in witchcraft, or else supernatural. The antidote to poison as thus conceived consists of an appeal to the same powers which produced the poison, or, in other words, to charms, or prayers, or incantations.

COSMOS MINDELEFF.

Prehensile-tailed salamanders.

It is not well to be hasty in accepting the idea that the tail of the salamanders is of so little value to them that they might get along quite as well without it. Observation proves the organ to be of constant use in pushing, when the animal makes its way among weeds, grass, rocks, or other obstructions. It is the main dependence of such as swim; and of climbing species its importance as a support and a lever is very manifest. Those suggested are general uses, common to all tailed batrachians. Particular species have the tail still more specialized. It is to some extent an organ for grasping in the long-tailed terrestrial species. A frequent practice of the 'spotted salamander,' Amblystoma punctatum, when taken up, is to curl the tail around the fingers or hand to prevent falling. Suspended thus, hanging head downward, it will again and again try to regain footing rather than drop. Peculiar serpentine curves, and the motions of the very flexible tip, often give the

tail of this species the appearance of feeling about for something, on its own account. The curves are so irregular at times, that the organ appears as if broken in several places. When at rest, some individuals have the habit of curling the tail closely against the body in a flat coil. Its capabilities are best seen in slender specimens, in which the tail is less thick and clumsy. Very likely Amblystoma jeffersonianum, and species of similar build, have the organ similar in sensitiveness and utility. Amblystoma mavortium, however, is lower in rank, and has the tail better adapted for swimming or pushing, as in other more aquatic forms. S. Garman.

Cambridge, Mass., June 27.

Association of official agricultural chemists.

The next meeting of this association will begin Thursday, Aug. 26, in the library of the Department of agriculture. All agricultural chemists holding official positions under the national or state governments, in agricultural colleges or experiment-stations, are entitled to membership. All other chemists interested in any way in the analysis of fertilizers or food-products are invited to attend the meeting, to present papers and take part in the discussion.

One of the chief objects of the association is to secure uniformity in methods of analysis employed. The attainment of such uniformity is of little less value than accuracy, in work of this kind.

I take this method of calling the attention of the chemists of the country, who are not members of the association, to the coming meeting.

H. W. Wiley,
Pres., and chairman of exec. com.

Washington, June 26.

Barometer exposure.

I have read with pleasure the paper referred to by Mr. Gilbert in his letter (*Science*, vol. vii. p. 571). His method seems to have shown, as clearly as could be without direct experiment, that the wind had the effect of lowering the barometer-readings in the building on Mount Washington. This direct evidence, if needed, has, I think, been supplied by the observations on Blue Hill, where it has been noticed, not only that the barometer in the building suddenly falls if the wind-velocity suddenly increases, but that during high winds the pressure in the building can be varied at will by merely opening and closing an aperture in the top of the building.

It does not seem unsafe, then, to draw one or two conclusions from these facts. In Loomis's tenth paper (*Amer. journ. sc.*, January, 1879), from an examination of a large number of storms, he arrives at the remarkable conclusion that "the low centre at the height of Mount Washington sometimes lags behind the low centre at the surface of the earth, apparently as much as two hundred miles." Mount Washington is only about one mile high; and if we draw two lines, — one to represent the earth's surface, and the other the storm-axis, — and make them diverge only one division in two hundred in length, the two lines will appear to the eye almost parallel. Such an inclination of the storm-axis seems incredible, and renders it probable that the apparent lagging was due to some other cause. Loomis shows, in this same paper, that the occurrence of high winds on Mount Washington from any easterly quarter is exceedingly rare; and in his eleventh paper he says, "In a majority of those cases in which an area of low barometer passes ever New England, attended by the usual system of circulating winds at the surface stations, this system of circulating winds does not extend to the height of six thousand feet." The effect of the indraught below only makes itself felt at the height of Mount Washington in front of storms by lessening the velocity of the prevailing westerly current, and in the rear of storms by increasing the velocity of this current.

This at once suggests that the apparent lagging of the storm-axis, or rather of the time of minimum pressure, on Mount Washington, is due to a mechanical effect of the wind on the observatory.

Mr. Gilbert has shown in his paper (pp. 531–533), from a series of observations, that wind-velocities of forty miles per hour from the north-west had the effect of lowering the pressure in the observatory on Mount Washington as much as eight-hundredths of an inch; wind-velocities of fifty miles, as much as thirteen-hundredths of an inch; and he estimated that wind-velocities of one hundred miles would lower it as much as half an inch. This equals any of the effects found by Loomis, and gives a plausible reason why the minimum pressure should occur later on Mount Washington than at sea-level. The same explanation applies to the lagging of the times of maximum pressure, since Loomis has shown in his second paper (*Amer. journ. sc.*, January, 1875) that the wind-velocities are larger in front than in the rear of maximum pressures.

Loomis also found that there was a lagging of the diurnal curves of pressure on Mount Washington and other mountains. He says in his tenth paper, "At the base of Mount Washington the principal maximum occurs at 8.30 A.M., but on the summit it does not occur until noon, being a retardation of three hours and a half."

Mr. Gilbert shows, on p. 526 of his paper, that from June 26 to June 28, 1873, some element on Mount Washington, which was undoubtedly the pressure, went through a diurnal variation coincident with the wind-velocity. During this time the wind each day reached a maximum near midnight, and a minimum near noon. This is a normal feature on high mountains; and if an increased wind-velocity tends, by a mechanical action on the building, to make the barometer read lower, it is readily seen that the pressure would tend to be lowest near midnight, and highest near mid-day. If, now, a double diurnal oscillation due to other causes be superposed on this, the chief maximum would occur much nearer noon than at lower stations, where the action of the wind is in the opposite direction.

The variations in the wind's velocity may not be the only cause of the phenomena considered in this letter. Loomis thinks that the wind-directions, and Ley that the upper cloud-motions, indicate a lagging of the storm-axis; and it seems probable that the expanding and contracting of the air from heat and cold have something to do with the occurrence of the chief maximum on mountains near noon, and in the lagging of the minimum pressure in storms; but the variations in the wind-velocity are undoubtedly an important factor, and it is very desirable that its influence might be eliminated.

H. Helm Clayton.

Blue Hill meteor. observ., June 28.

Recent Proceedings of Societies.

Natural history society, Trenton.

June. — Dr. C. C. Abbott stated that he has discovered how the bittern makes its booming noise. It is not a vocal sound. To produce it, the bird thrusts its beak into the soft mud, makes a vacuum, and the sound follows. Dr. Abbott says he has seen the bird engaged in this philosophic performance. —— Prof. A. C. Apgar remarked on the yellow iris (I. pseudacorus), which is uncommon in the state as a wild plant, but is now rapidly becoming rather abundant. —— Mr. Willard A. Stowell said, that, of the twenty-seven species and varieties of violet east of the Mississippi, New Jersey contains twenty, sixteen of which are found near Trenton. Mr. Stowell described the botanical structure, the habit of producing fruitful apetalous flowers, and the violent dispersion of the seeds by the valves of the ripe capsule. The rare V. striata is not uncommon near Trenton. —— Dr. C. C. Abbott stated that the specimen of white-crowned sparrow exhibited by him was the only one he has ever seen. He has said in print that the bird, while not abundant, is not rare; that it appears in September, and remains all winter, but that it does not breed in the state. —— Dr. T. S. Stevens referred to the complex rotatory disk of Melicerta, describing its anatomy, and especially the structure and use of the pellet-making organ. The process of forming the protective sheath was also described. —— Dr. C. C. Abbott remarked, that, as he could force a broom-stick into the ground and leave a hole, he concluded that burrowing animals made their tunnels by forcing themselves into the soft earth, thus forming and hardening the walls by the pressure of the body. On no other basis could he account for the absence of loose earth at the burrow-entrance. While exploring a tunnel, he found a tuft of unknown hair, which he then identified with a pocket-lens. —— Mr. Ernst Volk read a paper on the English walnut as cultivated here, detailing its method of growth, flowering, and fruiting, with the practical uses for which the wood and the expressed oil of the nut are esteemed, the latter being considered in Europe a valuable table oil. The tree would be a profitable one for extensive cultivation, and is worth attention.

Academy of natural sciences, Philadelphia.

June 22. — Mr. Thomas Meehan called attention to a species of Japanese oak, Quercus dentata. About ten years ago he had succeeded in raising one plant from a lot of acorns received from a correspondent. Since then the tree has grown with extraordinary rapidity, having now reached a height of eighteen feet. It was believed to be the only specimen of the species in America. The leaves are sometimes one foot in length by eight or nine inches in width. The structure of the acorn was of peculiar interest, the so-called stem being much longer than in any of the native species of oaks. —— Dr. William P. Gibbons presented specimens of the uterus of a viviparous fish from California, described by him in the Proceedings of the academy in 1853. His determination of the peculiar character of the species had been disputed at the time by Agassiz and other authorities; but he had since been able to trace the development from the ova to maturity, and he could now demonstrate, by a series of photographic illustrations, that the young were nourished as mammals are, by juxtaposition of the blood-vessels of the embryo with those of the parent. There is, however, no umbilical cord; but the young are held between folds of uterine membrane until they are ready to be extruded, when they are at once able to provide for their own future sustenance. Dr. Gibbons became a member of the academy in 1833. He removed to California shortly after his election, and it is nearly fifty years since he last attended a meeting of the society. But two or three of his contemporaries are now living, an entire generation having finished its work and departed in the mean time. At the time of his election the hall of the academy was in 'Georges Street,' a name afterwards changed to Sansom. William Maclure was still president, and the late Dr. Thomas McEuen acted as secretary. There were but three or four scientific societies of any importance in America, and among these the academy held the advanced rank which it still occupies. —— A communication was received from Dr. Persifor Frazer, requesting the academy to join with other scientific societies in inviting the International congress of geologists to hold in America the session following the one appointed to be held in London in 1888. The academy, by resolution, cordially united in the proposed invitation. The congress was first given tangible form at a meeting of the American association for the advancement of science, held in Buffalo in 1876. Meetings have since been held in Paris in 1878, in Bologna in 1881, and in Berlin in 1885. One committee has been appointed to harmonize conflicting views on the subject of the limitations and the names of geological formations, and another to select a color-scale for the representation of geological eras, the merits of which shall be first tested on a map of Europe. —— A resolution was also adopted tendering the use of the academy's hall to the Society of American naturalists, a meeting of which is to be held in Philadelphia during the coming season. —— George Vasey presented a paper entitled 'Notes on the Paspali of LeConte's monograph,' for publication.

Publications received at Editor's Office, June 21–26.

Abbott, Helen C. DeS. Proximate analysis of the bark of Fouquieria splendens. Philadelphia, *Amer. journ. pharm.*, [1886.] 8 p. 8°.

—— Yucca angustifolia: a chemical study. Philadelphia, *Trans. Amer. phil. soc.*, 1886. [31] p. 4°.

Adriance, J. S. Laboratory calculations and specific-gravity tables. New York, *Wiley*, 1886. 10+71 p. 12°. $1.

Brooks, F. Comparative size of metric and old units, with reference to convenience. (Journ. assoc. Eng. soc.) New York, *Atkin & Prout, pr.*, 1886. 28 p., illustr. 8°.

Carusso, C.-D. Importance de la cartographie officielle. Genève, *Charles Schuchardt, impr.*, 1886. 51 p. 8°.

Frazer, P. General notes on the geology of York county, Penn. Philadelphia, *Amer. phil. soc.*, [1886.] [20] p., map. 8°.

—— The application of composite photography to handwriting and especially to signatures. Philadelphia, *Proc. Amer. philos. soc.*, 1886. [9] p., 1 pl. 8°.

Gottsche, C. Land und leute in Korea. Berlin, *W. Pormetter*, 1886. 20 p., map. 8°.

Hicks, H. Results of recent researches in some bone-caves in North Wales. London, *Quart. journ. geol. soc.*, 1886. 19 p., illustr. 8°.

Japan imperial meteorological observatory. Monthly and yearly means, extremes, and sums for the years 1883–85. Tokio, *Imp. meteor. observ.*, [1886.] 85 p. 8°.

Long, J. H. On the microscopic examination of butter. (Bull. Ill. state micros. soc.) Chicago, *C. J. Johnson, pr.*, 1886. 5 p., 1 pl. 8°.

Ohio Wesleyan university, seventh annual report of the museum of. Delaware, O., *Mus. Wes. univ.*, [1886.] 8 p. 12°.

Patentee, the. *m.* Washington, *W. E. Lindsay*, 1886. 16 p. 4°.

Purdue university. Bull. No. 1: Pharmaceutical notes. Lafayette, Ind., *Amer. journ. pharm.*, 1886. 22 p. 12°.

Sternberg, G. M. Disinfection and individual prophylaxis against infectious diseases. (Amer. pub. health assoc.) Concord, N.H., *Republican press assoc.*, 1886. 40 p. 8°.

Toyo gakugei zasshi. Vol. iii. No. 56. Tōkyō, *Tōkyō Gakugeisha*, 1886. 48 p., 2 pl., map, illustr. 8°.

U. S. geological survey. Topographical maps of portions of Kansas, Utah, Missouri, Arizona, Nevada, New Mexico. 21 sheets, 42 by 50 cm. Washington, *Government*. 1886.

U. S. senate. Report of the joint commission to consider the present organizations of the government bureaus. (Report No. 1285, parts i. and ii.) Washington, *Government*. [1886.] 125 p. 8°.

United States, tenth census of the. 1880. Vol. xvi. part i.: Reports on the water-power of the United States. Prepared under the direction of W. P. Trowbridge. Washington, *Government*, 1885. 48+874 p., maps, illustr. 4°.

Van Hise, C. R. Upon the origin of the mica-schists and black mica-slates of the Penokee-Gogebic iron-bearing series. New Haven, *Amer. journ. sc.*, 1886. 7 p. 1 pl. 8°.

Viallanes, H. La photographie appliquée aux études d'anatomie microscopique. Paris, *Gauthier-Villars*, 1886. 6+66 p., pl. 12°. (New York, Christern, 70 cents.)

Warder, R. B. Commercial fertilizers, and notes on agricultural chemistry. Lafayette, Ind., *Purdue univ.*, 1886. 11 p. 12°.

Wronski, H. Exposé des méthodes générales en mathématiques. Paris, *Gauthier-Villars*, 1886. 10+314 p., illustr. 4°. (New York, Christern, $4.)

Zeitschrift für hygiene. Band i. heft 1. Ed. by R. Koch und C. Flügge. Leipzig, *Veit*, 1886. 192 p., 3 pl., illustr. 8°. (New York, Christern $12.50.)

Advertised Books of Reference.

SCIENCE.—SUPPLEMENT.

FRIDAY, JULY 2, 1886.

ECONOMICS AND JURISPRUDENCE.

MR. INGRAM, in his excellent article upon political economy in the 'Encyclopaedia Britannica,' states as a characteristic feature of the historical school of economists, that they recognize a close relation to exist between economics and jurisprudence. "The point," he says (and this he takes from Dr. Adolph Wagner of the University of Berlin), "upon which all turns, is the old question of the relation of the individual to the community. Whoever, with the older juristic and political philosophy and national economy, places the individual in the centre, comes necessarily to the untenable results which, in the economic field, the physiocratic and Smithian school of free competition has set up. Wagner, on the contrary, investigates before every thing else the conditions of economic life of the community, and, in subordination to this, determines the sphere of the economic freedom of the individual." It is my purpose in what follows to expand somewhat the view thus expressed, and to show why it is impossible for the economist to arrive at just conclusions in economic matters unless he consciously allows his thought to be influenced by a keen appreciation of the science of jurisprudence, as also of the juridical structure of the society to which his attention is addressed.

It may avoid some misapprehension if we state clearly at the outset what is meant by the terms 'jurisprudence' and 'economics.' In the science of jurisprudence it is common to consider the legal structure of society, that phrase being used in its broadest sense. It might indeed be said that this science builds the framework of society, were there not danger of pressing the metaphor so far as to give rise to the conception of a purely mechanical arrangement in human relations. Questions of government, if they do not pertain to administration or to pure politics, find treatment under jurisprudence, as also do established customs which grant personal rights and liberties, and established laws which determine the nature of property. Or, to state the matter concisely, the material out of which a science of jurisprudence is formulated is, 1°, "the essential institutions of human society, by the use of which the objects of that society are carried out through the medium of government;" 2°, the established opinions of society, expressed in law, by which rights and duties, liberties and limitations, are determined for individual members of society.

Economics, on the other hand, deals with industrial activity. It has to do with men, with corporations, and with governments as industrial agents. It may, indeed, be properly defined as the science of industrial society: and one obtains for the first time a clear view of its general bearing when he discerns its subordinate relation to the science of society as a whole. The material out of which this science is built includes, 1°, the economic nature of man, to which all industrial activity may be traced; 2°, the material surroundings of men, to whose physical laws their industrial activity will in the long-run conform; 3°, the legal structure of society, which conditions the exercise of such industrial rights as are granted. None of these factors may be disregarded by the economist, if he would arrive at correct conclusions respecting the industrial actions of men; and the 'lego-historic' facts, although they may vary from time to time, are of as much importance while they last as the permanent facts of nature. Throughout the entire history of the world, until the dawn of what we technically term 'modern times,' the form of undertakership was dependent on the political structure of society. We observe property rights to have developed from communal to personal ownership; and with each step in this direction there has been a corresponding development of industrial methods. It has frequently been pointed out that personal liberty, and the freedom of action that it implies, were necessary to the realization of the industrial organization with which we are now familiar. And it is not too much to say that the economic character of man itself has been modified by means of the hereditary transmission of habits first contracted through the pressure of changes in the social structure; for, as the stroke of the shuttle is limited by the framework of the loom, so the industrial movements of men are bound by the liberties of law and of custom, and, to carry the metaphor a step further, the industrial weaving of society is largely determined by its legal structure.

If the analysis thus suggested be correct, one cannot disregard the close relation that exists between economics and jurisprudence. Both branches of thought are part of the larger study of society, and neither can be satisfactorily pur-

sued to the exclusion of the other; at least, the economist must hold ever in view the juridical system of the society with which he is concerned in order to fully explain the facts he may observe.

Such statements as the above, however, do not seem to adequately present the views entertained by historical economists. Not only does the jural system influence economic activity, but the theory of jurisprudence at any time accepted has much to do in giving shape and color to the accepted theory of economics. This is not a matter of speculation. It is declared by the history of both jurisprudence and economics during the last one hundred years. It will probably pass without question, that political writers of the last century, whose enthusiasm sprang from a desire for the free exercise of all manly powers, assumed some conception of inalienable rights as the basis of all their important arguments.

The rule of authority which they endeavored to shatter was the *jus dei;* and it was wholly logical, that, under the direction of such a rule, society should be regarded as a mechanical appliance permanently imposed upon men by some power outside society itself. This idea was shattered by the victory of French philosophy, but this did not go very far in realizing for the men that freedom which they sought. Its full effect, indeed, was to supplant the *jus dei* by the *jus naturae;* and though this change may have had decided results, extending political rights, the new principle adopted exercised as great a tyranny over men's minds as it was ever possible for any conception of a divine arrangement in the affairs of men to exercise. It was this new principle, first well formulated by political philosophers in their criticism upon the existing structure of government and jurisprudence, this desire to secure some natural law for the conduct of the affairs of men, that gave character to English political economy. English economy, indeed, is but the application of the *jus naturae* to industrial affairs. Or, to speak of modern economists, the historical school itself is an historical development. The views of this school, says Mr. Ingram, "do not appear to have arisen, like Comte's theory of sociology, out of general philosophical ideas: they seem rather to have been suggested by an extension to the economic field of the conception of the historical school of jurisprudence, of which Savigny was the most eminent representative. The juristic system is not a fixed social phenomenon, but is variable from one stage in the progress of society to another: it is in vital relation with the other co-existent social factors; and what, in the jural sphere, is adapted to one period of development, is often unfit for another. These ideas were seen to be applicable to the economic system also. The relative point of view was thus reached, and the absolute attitude was found to be untenable. Cosmopolitanism in theory, or the assumption of a system equally true of every country, and what has been called perpetualism, or the assumption of a system applicable to every social stage, were alike discredited. And so the German historical school (of economists) appears to have taken its rise."

But we have not yet arrived at a full statement of the relation that exists between economics and jurisprudence. The modern school of political economy goes further than merely to recognize the existence of such a relation as has been suggested above. Having formulated a theory of society in harmony with the teachings of the science of history, the adherents of this school endeavor to bring their economic doctrines into accord with their social theory. It would be incorrect to claim uniformity of opinion respecting any theory of society. The Germans, in their general discussions, use the word 'state' as representing the final analysis of human relations; English and American writers, when they endeavor to present German ideas, employ the word 'nation;' and perhaps I show the leanings of my own mind in choosing the word 'society.' But whether 'state,' or 'nation,' or 'society,' the fundamental thought is the same. The thing itself brought to view is an organic growth, and not a mechanical arrangement. The springs of its action are not imposed from without, but lie wholly within itself. The law of its own development is the only permanent and universal fact which its analysis discloses: all other facts are relative truths; and those systems of thought based upon them, temporary systems.

But there are two ways in which this organism — the state, the nation, society — may be regarded. It may be regarded as an organism moved by no conscious purpose, and consequently with no control over the course of its own growth; or it may be conceived as a continuous conscious organism that is capable of placing before itself an ideal structure to be attained. The first conception reduces society to the grade of a physical organism. It places social relations under the same law of evolution that is disclosed by a study of the organic world. But, as Mr. Ward truly says, the philosophy of evolution applied in this manner to society becomes sterile, "because, while justly claiming a social science, it falls short of admitting its complete homology with other sciences, and, while demonstrating the uniformity of social as of physical phenomena, it denies to the former that susceptibility to artificial modifi-

cation which, applied to the latter, constitutes the only practical value that science has for man." The second conception of the social organism endeavors to correct the error thus pointed out. It recognizes in society a power of self-control. It admits the truth of M. Thiers's sentence, that 'the nation is that being which reflects and determines its own action.' It holds it as useless to stop one's study with a reading of nature, and refuses to allow that the perfection of human conduct consists in following nature. The *jus naturae* finds first its true place when subordinated to the *jus hominum*.

I do not wish to be drawn from the question in hand to a discussion of the general theory of sociology, but the distinction that has been pointed out appears to me essential for a just appreciation of any study whatever that has to do with social relations. It lies back of the theory of both economics and jurisprudence, and points out the manner in which each may exercise an influence on the other. If we adopt the view that the social organism is subject to the same law of development as a physical organism, our study will be crowned only by negative results. *Laissez-faire* would then be logical, and the philosophy of anarchy inevitable. But if, on the other hand, we perceive that society may have a conscious purpose, we have discovered a scientific basis for positive and constructive study. We find that no incongruity exists in uniting the science and the art of society in the same discipline. The law of evolution, with its 'survival of the fittest' and its 'adaptation to environment,' comes to be the basis of a scientific theory of revolution or of reformation; for the fittest type to survive may first exist in the conscious purpose of society, and be realized by means of an environment arbitrarily determined.

This view of social relations leads to certain practical results in the study of economics that cannot be overlooked; and of these, none is perhaps more important than the new light thrown upon the nature and limitation of legal enactments in the process of social growth. The sphere in which law exerts a direct influence is quite restricted, but within that sphere it becomes a most efficient agency. Every change in law means a modification in rights; and when familiar rights are changed, or, what amounts to the same thing, when new duties are imposed, the plane of action for all members of society is adjusted to a new idea. In many instances legal enactments undertake to enforce certain lines of conduct on a stubborn minority; but this is not always the case, nor is it the most fruitful assistance rendered by law in the realization by society of its conscious purposes. As contrasted with this, it may occur that the entire community is in favor of some method of procedure, and yet the practice will be universally disregarded unless granted the sanction of law. This fact, which may at first seem strange, is easily understood when it is noticed that men are more powerfully moved by immediate than by ultimate interests, and that, in the absence of a law which restrains all alike, the fierceness of competition will lead individuals to disregard public opinion, even though they admit the rightness of its commands: for each man says to himself, "If I do not do this thing, which, I confess, is to the permanent injury of society, some one else will; the evil will be done, and I will lose the personal advantage of the doing of it. But pass a law which restrains alike my neighbor and myself, and I will gladly obey it." That is to say, public opinion considers the social interest; and with this the individual interest does not always harmonize. The one holds in mind the ultimate, the other the immediate, results; and the only way in which the social purpose can influence the practice of individuals is for law to establish uniformity of action. This is the most important use of law as an agency of reform. The thought has nothing to do with 'paternal government,' but is in perfect harmony with the idea of democracy. It is the means by which the social organism may realize its conscious purpose, and it needs no words of mine to show how important is this view of the efficiency of law in matters pertaining to industrial organization. The constructive economist is forced to admit its pertinency.

But there are other conclusions which spring from this idea of social relations, and which are of especial interest because they touch directly the great economic questions of the day. This is a time when much is heard of industrial re-organization as a means of solving the social problem; but the lesson taught by the foregoing analysis is, that, in all matters pertaining to re-organization, it should be held as a first principle to maintain harmony between the various parts of the social order. A study of history declares that no part of the social structure may be considered as good or bad in itself. What appears now to be wholly pernicious may once have been capable of complete defence. Most of the evils experienced, so far as they spring from established law or permanent custom, may be traced to the fact that some right or custom has outlived its time, or that some principle, in itself just, fails to be applied to all departments of social activity. We need not turn the pages of history in search of examples of uneven and disjoined development: the source

of prevalent complaint is found in the fact that the conception of rights and duties, of liberties and constraints, of privileges and responsibilities, which lies at the basis of our juridical system, is not applied to the highly developed industrial system of the present. Difficulties have arisen because the industrial life and activity of the social organism have grown to a different plane from the one which underlies the juridical system. The piston of the social engine demands a longer stroke, the shuttle freer play, and the stationary settings of the machinery are rapped and battered in consequence. This thought may be amplified by the following suggestion, which, while being interesting in itself as bearing upon the great social question, will serve to further illustrate how closely are the sciences of jurisprudence and of economics related to each other.

The idea of liberty, which is an idea germane to every system of jurisprudence, finds its best practical presentation in English law. The peculiar feature of this English conception of liberty is, that every man is allowed full control over his own acts on condition of complete responsibility for all that may ensue from them. This is the basis of responsible government. It is well worked out in both criminal and civil law. It gives color to all thought on freedom of speech and freedom of the press. It rests, for its logical defence, upon the claim that the exercise of any power which touches the lives of others is of the nature of a grant to him who exercises it. But though this theory, that liberty is only possible under responsible exercise of power, is in good working-order so far as political and jural affairs are concerned, its controlling principle has never yet been adequately applied to the field of industrial activity. The most effective power of the present day is capital, for by means of capital the forces of nature are brought to serve the industrial purposes of men. But all men who work as business-agents must conform to the economic law of capital. In this day all must work with machinery, or not work at all; and yet the law of property, which grants ownership in capital, does not recognize its public character. The consequence is, that we find a power, which necessarily touches the life of every man, managed for purely private ends. This is contrary to the spirit of English liberty.

Could we carry the principle of responsible power over into the field of economics, and so adjust matters as to realize responsible control over all economic agencies, the industrial problem would, in my opinion, be as perfectly solved as its conditions will admit; and, what is of more importance, such a solution would be in full harmony with the form of Anglo-Saxon liberties. We have also every reason to believe that it would be satisfactory and final, for it consists in the extension of a principle well tried in our jural and political system to the industrial life of men.

The tendency of events has already set in this direction. Certain businesses are regarded as of a *quasi*-public character, and on that ground are adjudged to be under the control of the law. For example: the decisions in the so-called Granger cases established for law, and in public opinion, the right of the states to control railroad property; and the only question that now remains pertains to the best method of control. But there is no difference, except in degree, between the railroad business and many other lines of business. All businesses that escape in any marked degree the regulative influence of competitive action fall under the same rule. The community as consumers may set up a just claim for legal regulation, and defend the claim by the doctrine of English liberty. This, however, does not touch the labor problem, except as laborers are themselves consumers. Still the principle of responsibility is, in my opinion, adequate to the solution of this phase of the question also, though in this case it pertains to the relation existing between the employer and the employee. The fundamental point at issue is a question of industrial organization in the several industries. Private ownership in capital must be allowed, in order to secure its most economical administration; but there is no reason why its administration should be irresponsible. It is from its very nature a social force; and not only should the community as a whole have a word to say respecting its management, but the employees also, as members of the community. This can be done by increasing the duties of property, which would be equivalent to the creation of proprietary rights for the non-possessors. It is at this point, I trust, that American economics will part company with German socialism. It may be proper in Germany, where the principles underlying the juridical system are quite different from those that determine either English or American law, to advocate constructive socialism; but it is absurd for one who claims to be a disciple of the historical school of economy to adopt German conclusions in this respect. Our entire juridical structure is against it, and it is easier to bring our industries into harmony with the spirit of our law than to re-organize our society from top to bottom, industries included. At least, this line of reasoning is a fair illustration of the close relation that exists between jurisprudence and economics.

This subject is capable of indefinite expansion. Indeed, I have purposely omitted a consideration

of the most apparent influence of the jural upon the industrial system, because, in the series to which this article belongs, it will find special treatment from another point of view. I refer to the effect of the law of property on general distribution, and the effect of distribution — through consumption — upon the entire economy of production. What has been said is suggestive rather than conclusive. It leads to the conception that political economy is a constructive as well as a formal study; that it is a subordinate and not an independent study; and that, so far as jurisprudence is concerned, not only does the jural system assist in explaining many facts of industrial life, but it may be advantageously used by society in the realization of industrial ends.

HENRY CARTER ADAMS.

ZOÖLOGY AT THE COLONIAL AND INDIAN EXHIBITION.[1]

ZOÖLOGICAL knowledge is of such fundamental importance for the advancement of material prosperity, that the thoughtful visitor to a great exhibition may profitably inquire how high the various colonies now represented at the exhibition estimate a scientific acquaintance with natural objects. It is a matter for congratulation that some of the persons responsible are not of the school of Professor Huxley, so far as that distinguished naturalist believes that men of science are incompetent administrators: the Indian empire has as a commissioner Dr. Watt, a well-known botanist; the Canadian dominion is represented by the distinguished geologist, Dr. Selwyn; and the New Zealand court is directed by the eminent zoölogist, Dr. Julius von Haast.

On the whole, the zoölogist will, we fear, be disappointed with the show provided for him. In some of the courts the specimens might have been turned to better account; in others mere show-cases of brilliant birds, or, still worse, poor collections of common shells and corals, are the only objective signs of an interest in zoölogy. The idea of having a representation of the fauna of a particular district is excellent, and, had it been always well carried out, the present exhibition would, from the naturalist's point of view, have been really admirable. The best illustration of this kind is afforded by South Australia, the worst by the Indian empire. The latter exhibits so much technical skill in detail, that it is really irritating to find the general result so confused and ridiculous; a rock-snake on a tree, a crocodile on dry ground, are too trying to our patience. South Australia is very good as far as it goes, but it is not free from the objection to which West Australia and Queensland are still more obnoxious — the fauna of none of these places consists only of birds and mammals.

A most excellent and instructive show is made by New Zealand, the land of the recently extinct Dinornis, the wingless Apteryx, and the curious, low, lizard-like form Hatteria. The Otago university museum is an important contributor, and visitors and experts alike will admire the very beautiful specimens of cartilaginous skeletons which have been prepared under the direction of Prof. T. Jeffery Parker — worthy son of a worthy father. Among the shark-like forms here seen, should be noted especially Notidanus, which is remarkable for having its lower jaw, not merely connected with the skull by the upper half of its mandibular arch (as is the case in all pentadactyle vertebrates), but also by the hyoid (as is the case in the great majority of fishes), or for, in other words, exhibiting what Professor Huxley has called the 'amphistylic' mode; Callorhynchus, which is the southern representative of the northern 'holocephalous' Chimaera; and the bony Regalecus argenteus, one of the longest of the ribbon fishes, a memoir on which by Prof. T. J. Parker has been lately published by the Zoölogical society of London. Among the birds there stands in a prominent position an excellent skeleton of the gigantic moa (Dinornis maximus); there is an interesting group of Apteryx, as well as some well-stuffed specimens of the avifauna; the visitor may chance to hear a sheep-farmer dilating on the enormities of the kea parrot. There is a good collection of dried fish, and among the spirit specimens there are a number of species which, having been insufficiently described, will be gladly examined by stay-at-home naturalists. Of the teaching collections of the museum, it need only be said that they show quite as high a standard of preparation as the best to be found in our own country. This is quite the best zoölogical exhibit in the whole show, and the excellent preparation of the octopus is not the only one which may be profitably studied by curators of English museums.

Perhaps the exhibit which comes next in importance is that of Canada, where there is a really fine collection of fish and marine invertebrates, all well and carefully catalogued; the government of the dominion is to be congratulated on this proof of its interest in natural history. The authorities at home may, perhaps, be inclined to deduce the moral which presses itself on ourselves; the Canadian government has a department of fisheries, to which, in the year ending June, 1884, $116,531 were allotted. There are some very fine heads of mammals in other parts of the Canadian

[1] From *The Athenæum*, June 12, 1886.

court; we have reason to know that a catalogue of the birds to be exhibited has been printed off, but the birds themselves do not seem to have yet arrived in England. We imagine that some such accident must have happened also to the exhibits of the Australian museum at Sydney, for this institution, which was well represented at the fisheries, has here a very poor show, which would, indeed, be improved were the specimens named. The finest set in the New South Wales court is the magnificent collection of shells lent by Dr. Cox, who is well known for his interest in zoölogy; the specimens are not named, but the catalogue gives their localities.

The Straits Settlements court is badly lighted, and appears to be cramped for space; this must explain why the really valuable collection of fish made by Dr. Rowell of Singapore has been placed on the wall with an eye rather to decorative effect than to scientific use. Dr. Rowell's collection contains also some good Crustacea, among which we notice a well-preserved example of the palm or robber crab (Birgus latro), the air-breathing apparatus of which has been described by Professor Semper.

In the neighboring court of British Guiana, we were most struck with the collection of nests of wasps, bees, and ants; but it is a pity that little information is given as to the species by which they were severally constructed.

In the court of the Bahamas there is a wonderful collection of more than sixty specimens of Oreaster reticulatus, which offers the zoölogist an opportunity for making a careful inquiry into the range of variation of this species. There are four, six, and seven rayed forms, as well as the more ordinary quinquiradiate specimens.

In the Barbadoes court there is an exceedingly interesting exhibit in the two specimens of Holopus rangi, which are lent by Sir Rawson Rawson. This very rare crinoid, described in 1837 by D'Orbigny, was incompletely known till Dr. Herbert Carpenter gave an account of the three specimens obtained by Sir Rawson when governor of the Windward Islands, and one in the possession of the Museum of comparative zoölogy at Cambridge, Mass., in his report on the stalked crinoids of the Challenger expedition. Holopus has been personally seen by so few naturalists, that they will be glad to have an opportunity of inspecting this enigmatic form for themselves; it is appropriately placed in a jar with a specimen of Pentacrinus muelleri, and, as that jar has flat sides instead of being round, the visitor will be able to see the specimens free from the distortion which is inseparable from a rounded jar.

In the Natal court there is a large collection of Lepidoptera and other insects in drawers, and a collection of birds which have, we believe, been examined by Captain Shelley, who is an authority on the avifauna of Africa. There is also a large case of insects in drawers in the Straits Settlements court, which have, no doubt, been examined by Mr. Distant.

The dugong in the Queensland court is, if our memory serves us rightly, a finer example than either shown by New South Wales in 1883; here, too, is a fine sawfish. The trophy of mother-of-pearl shells in the West Australian court is impressive. As to the spat of the pearl oyster shown in the Ceylon court, we will only say that the exhibiter is not at one with the authorities of the British museum, or with the specimens exhibited in the shell gallery of the Natural history department of that institution; the small Avicula vexillum is not the young of A. furcata.

A THEORY OF CRIMINALITY.

In Italy, during the last few decades, a number of scientific men, mostly physicians, have devoted themselves to a careful study of criminal types. Their point of view is a strictly scientific one: they regard a crime as the expression of a dangerous trait of character. The character is more important than the act. Moreover, the criminal is not a spontaneous, capricious product: he does not stand alone, but belongs to a class. Thus the anthropology of the criminal classes becomes a distinct object of study. Again: criminality is essentially a morbid phenomenon, and is a defect analogous to insanity or idiocy. In this aspect the criminal is a psychological study. To characterize the spirit of this movement in a few words, one may say that it lays stress on the criminal rather than on the crime.

Foremost among the representatives of this view is Dr. Lombroso, the editor of a journal devoted to this movement, and author of a comprehensive work on the defective classes (*l'uomo delinquente*). Dr. Lombroso has recently stated his theory of criminality in a review article (*Nouvelle revue*, May, 1886), and it may be worth while to take advantage of this convenient statement by presenting it to English readers.

In general, one may recognize three types of causes of the outbreaks against the social order,—physical, social, and anthropological. Among the first may be mentioned climate. In the Argentine Republic the sharp changes of temperature favor a revolutionary character in the inhabitants. The season of year influences the amount of crime: crime predominates in the warm months. Of 192

revolutions in Europe, the months of June and July have the largest share; November and January, the smallest. So, too, heat is a factor. Southern countries (Italy, Spain, Greece) have the largest number of revolutions: northern countries (Russia, Sweden, Norway) have the least. Geographical position and other physical causes could be added. As social causes, Dr. Lombroso regards the struggle for supremacy among the various social castes or classes, a disharmony between the existing civilization and the prevalent economic conditions, an opposition between the political forms and the national feeling and needs. Such are the more constant occasions of revolutionary outbreaks, as shown in history. Mere accidental circumstances, such as the appearance of a great leader or writer, must also be considered.

Finally, the following are the prominent anthropological causes: the co-existence of races not readily assimilated, with, perhaps, a tendency to political changes; hereditary anomalies of character, such as criminality and moral insanity; or acquired anomalies, as alcoholism and insanity. All these go to form three classes of political defectives, — criminals by heredity, by habit, and by mental disease. These have furnished the subject-matter to the new science of criminal anthropology.

One must not suppose, that, because these criminals are classed under the insane, they will not be active in political crimes; for though they may be men of small intellect, yet the absence of the restraining power of a well-developed moral sense makes the bridge between thought and action shorter and smoother. A mere fanciful conception of possible crimes will take so strong a hold on their minds that the act itself will follow. More sensible and reflecting criminals would be repelled by the consequences and dangers of the act. In addition to this class of criminals, who become breakers of the peace simply because that happens to be the most accessible method of venting their perverse instincts, there is another class, who are led on by a wild passion for the destruction of the old, and the creation of something new. They need restless activity: their present condition seems the worst possible. As a rule, too, they are very fond of notoriety. They are in love with crime. The pain of others is a keen satisfaction to them: its horror attracts them. The French revolution shows such types. Lejeune made a little guillotine, and used it on the chickens destined for his table. Jean d'Heron wore a human ear as a cockade on his hat, and had others in his pockets. Carrier confessed that the writhings of the priests whom he condemned to torture gave him exquisite pleasure.

The modern socialists, anarchists, and dynamiters no doubt contain an element of these hereditary criminals, who use the political object as a mask for their instinctive tendencies to lawless outbreaks. The socialistic and the criminal types of face present strong resemblances. In some cases the introduction of such a criminal element transforms a purely political organization into a band of outlaws: the Molly-Maguires are an example of this.

All these facts urge the study of these defective classes. Society has a right to defend itself against these enemies of all peace and progress. But the punishment must be directed to the removal of the evil. The born criminal can readily be detected: his craniological peculiarities, the absence of a moral sense, the reckless cruelty of his deeds, point him out. The treatment for these must aim at removing all opportunities of indulging their passions, for meeting others of their kind (for the epidemic contagion of this disease is one of its worst characteristics), for bringing into the world others fated to follow in their footsteps. For their children, houses of correction and careful discipline should be at hand.

The relation between insanity and crime is one both of cause and of effect. Esquirol has shown an increase of insanity and suicides at each outbreak of the French revolution. Lumier declares that the excitements of 1870 and 1871 were the more or less indirect causes of seventeen hundred cases of insanity. This simply means that the same morbid element, tending to pronounced insanity in one direction and to pronounced criminality in another, is brought to the front by a common cause. Very frequently, too, both tendencies can be seen in the same individuals. Marat, for example, had attacks of maniacal exaltation, and a passion for continually scribbling. He had a sloping forehead, was prognathous, had a prominent jaw and high cheek bones, and a haggard eye, all of which correspond closely with the insane type of face. Later his delusion of ambition changed into one of persecution and homicidal monomania. Dr. Lombroso cites case after case, all telling the same story. He includes Guiteau in this list, and agrees with the opinion of an Italian alienist, that his trial was simply 'scandalous.' The real place for such beings is in a much needed institution, — an asylum for insane criminals.

A few words as to criminals who have acquired their sinful traits. Alcohol is the most common cause. This always plays a prominent *rôle* in political outbreaks: the French revolution is no exception. Here is another great practical problem needing solution.

So very hasty a sketch of an important theory is necessarily unsatisfactory. It may serve, however, to call attention to the fact that a change in our view of crime and criminals seems about to take place.

The several interests involved in this change of view are many and important. When a chemist is called to court to give expert testimony, the law accepts the results of science as final: but when the doctor testifies, it is at once evident that the medical and legal points of view are essentially different, and in conflict with one another. The law is interested only in the question of responsibility, and demands a 'yes' or 'no' when a truly scientific answer cannot be given in that form. A medico-legal case almost always presents strange inconsistencies. The law should certainly be as ready to accept the testimony of science from the doctor as from the chemist, and should remember that they may both be equally valuable though not equally definite. If such views as these urged by Dr. Lombroso ever become the guiding principles of the law courts, a great and beneficial change in the treatment of alleged insane criminals is sure to follow. Our knowledge of these marked classes is becoming sufficiently accurate and scientific to warrant a practical application of these views in the legal trials, and a theoretical appreciation of them in our theories of ethics.

J. Jastrow.

ANNALS OF THE CAKCHIQUELS.

The above forms the sixth volume of the editor's 'Library of aboriginal literature,' and contains a portion of a manuscript termed by Brasseur de Bourbourg, its former proprietor, 'Mémorial de Tecpan Atitlan.' Its language is the Cakchiquel dialect of the wide-spread Maya family: it was composed by various members of the Xahila (a clan or family once ruling among that tribe) during the sixteenth century, and brought into its present form, as Dr. Brinton assumes, between 1620 and 1650. Only that half of the manuscript was published by him, with translation, which refers directly to the legendary and documentary history of the tribe.

There are three ways open for the publication of linguistic manuscripts of this sort. The first is to print the text, *tel quel*, with all its faults and inconsistencies; the second, to emend the faulty text according to the grammatic laws observable in the language, and to place the readings of the original, where they differ from the corrected forms, on the lower margin. A third mode of proceeding, and the most scientific of all, would be to embark for Guatemala, and there to compare the old text with the pronunciation and wording which the actual Cakchiquels would give to it. This would enable the editor not only to present the text in a scientific alphabet, but also to add a correct translation to it.

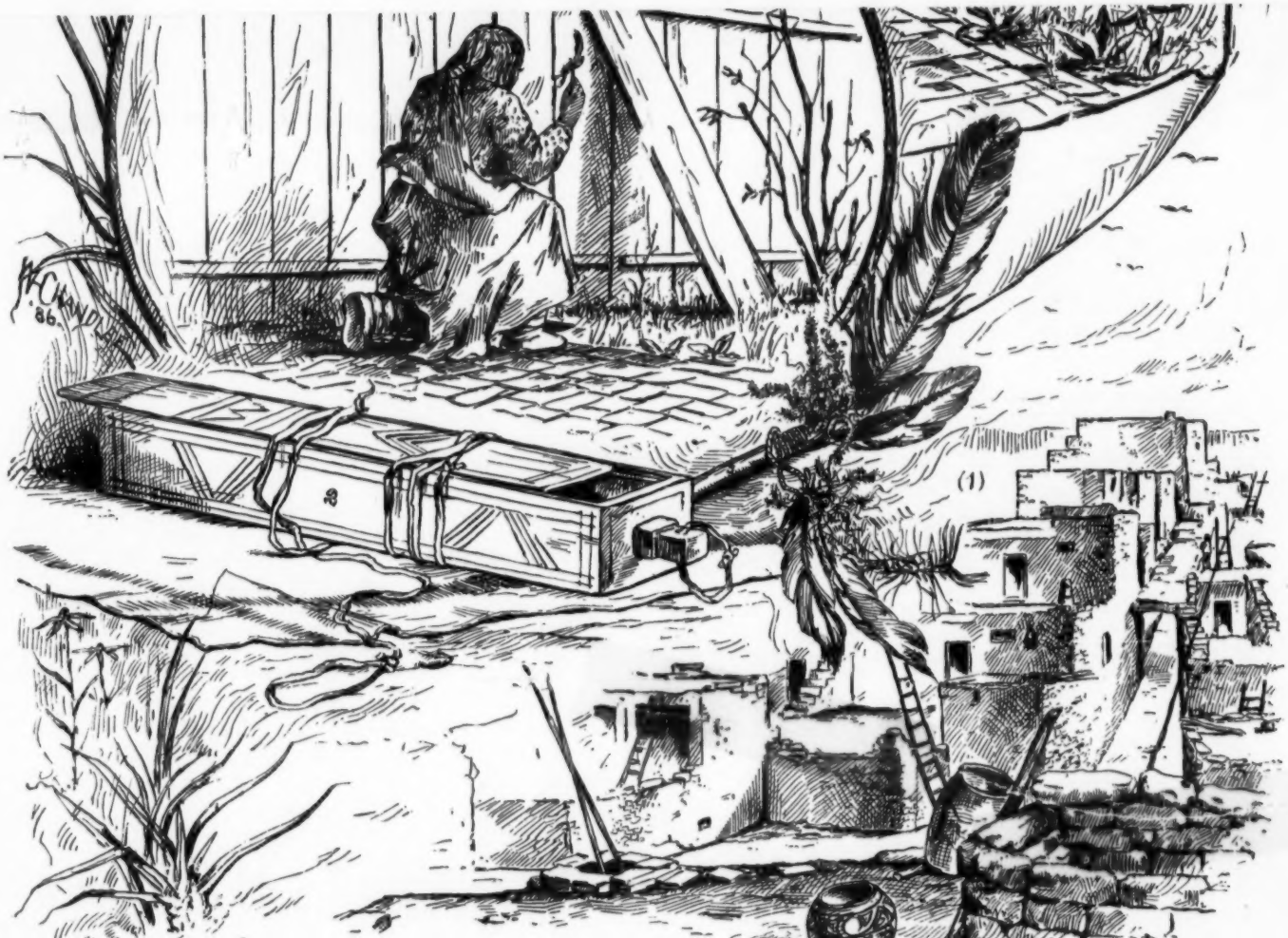
But none of these three courses was followed by our editor. The inconsistent orthography of the original prompted him to adopt the first two courses simultaneously and eclectically, and thus he succeeded in producing confusion in the text. His excuse (p. 63) is, "I have felt myself free to exercise in the printed page nearly the same freedom which I find in the manuscript. At first, this will prove somewhat *puzzling* to the student of the original. . . . In the punctuation I have also been lax in reducing the text to the requirements of modern standards."

Not less unfortunate than this method is the incorrectness of his proof-reading; for on p. 107 we find the proper name *Vookaok* correctly written, but on p. 110 he prints it *ahauh voo kaok;* the adverb *mahaniok* (p. 66) appears in the vocabulary as *mahanick;* the Greco-English term *allophylic* (p. 196) as *allophyllic;* and in two French quotations from Brasseur's translation he finds himself prodigiously at variance with French accentuation (pp. 197, 206). The appended 'Notes' convey very little information on grammatic or other subjects which we have to know before we can understand the text, and the condition of the vocabulary is very unsatisfactory. We look in vain for the terms *petebal, navipe, onohel, g'anel* (the name of a month); and even some of the frequently occurring numerals, as *vuo–o, voo* ('five'), are not entered. The translation is a mere paraphrase full of gaps, and the text as printed does not by any means render justice to its highly interesting contents, which, in their historic importance, are second only to those of the Popol Vuh.

The annals of the Cakchiquels. By Daniel G. Brinton. Philadelphia, *Brinton*, 1885. 8°.

Professors Ayrton and Perry, the English electricians, have accidentally observed that on amalgamation, or coating with quicksilver, brass expands; so that, if one side only is amalgamated, a plate of brass becomes curved. They imagine that this may be the primary cause of the phenomena of the Japanese 'magic mirror,' which has cast on its back a pattern that is quite invisible on the polished face, yet is mysteriously distinct in the patch of light reflected by the mirror upon a screen. Amalgamation would affect the thinner parts made by the pattern more than the rest of the plate, giving the mirror the imperceptible unevenness that becomes plainly apparent in the reflected image.


5
6


(1)

SCIENCE, July 9, 1886.

BURYING A PRAYER IN WASHINGTON: A REMNANT OF AN EXPIRING WORSHIP.